

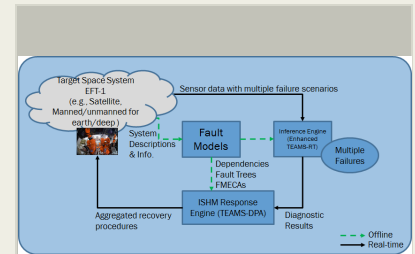
Integrating ISHM with Flight Avionics Architectures for Cyber-Physical Space Systems, Phase I

Completed Technology Project (2016 - 2016)



Project Introduction

Autonomous, avionic and robotic systems are used in a variety of applications including launch vehicles, robotic precursor platforms, etc. Most avionic innovations are based on software-embedded systems, and this has resulted in an increase in the number of interactions (coupling) among heterogeneous subsystems. Avionic systems degrade in performance due to gradual development of anomalies and unanticipated failures ranging from issues affecting a single hardware or software subsystem to issues occurring as a result of coupling among multiple subsystems. In addition, system usage and operating conditions may lead to different failure modes necessitating multiple recovery procedures possibly causing conflicts and deadlocks among recovery steps. QSI intends to address these challenges by leveraging the current capabilities of model-based fault management and supportability solutions of TEAMS to efficiently sequence individual steps within each procedure, including adding/deleting steps, and resolve conflicts and deadlocks in recovery procedures. TEAMS-RT, the real-time inference engine, has multiple fault diagnosis capability built-in. Additionally, TEAMS-RDS (TEAMS-remote diagnostic server) already exploits commonalities among test steps during guided troubleshooting, where each test is represented as a chain of pre-setup, post-setup and action nodes with Do and Undo steps interspersed. The proposed effort will extend this to more general digraphs of test and recovery/repair procedures and also embed this capability in a solution linked to enhanced TEAMS-RT for automated /crew-initiated recovery and resolution of conflicts and deadlocks in recovery procedures. This proposal aims to enhance QSI's existing probabilistic inference engine to handle multiple, intermittent and coupled failure scenarios and developing an ISHM response engine module that dynamically assembles feasible and near-optimal recovery procedures to handle multiple failure scenarios.



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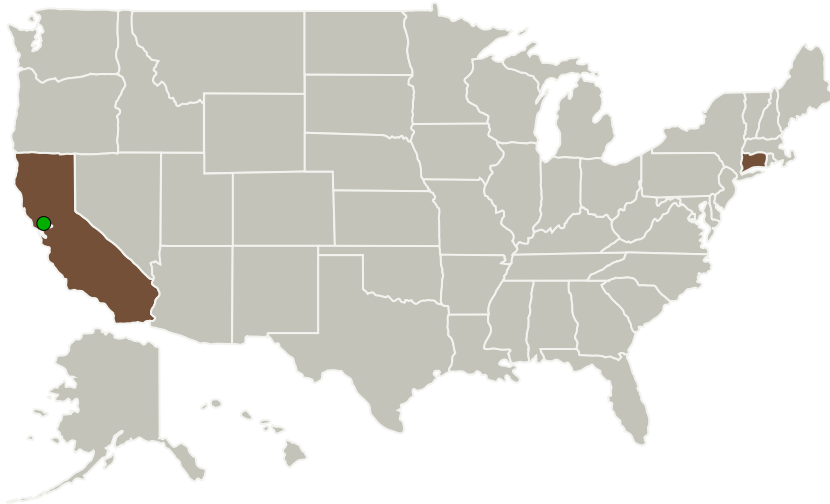
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Qualtech Systems, Inc.	Lead Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Rocky Hill, Connecticut
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations

California	Connecticut
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Project Transitions

**June 2016:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Qualtech Systems, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

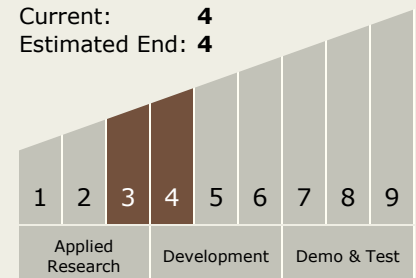
Carlos Torrez

Principal Investigator:

Sudipto Ghoshal

Technology Maturity (TRL)

Start: **3**
 Current: **4**
 Estimated End: **4**



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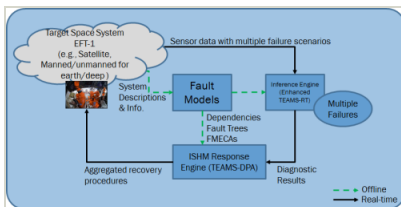


✓ **December 2016:** Closed out

Closeout Documentation:

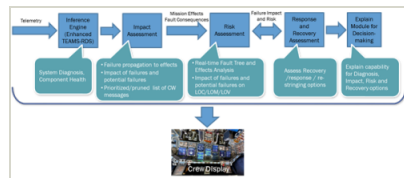
- Final Summary Chart(<https://techport.nasa.gov/file/139586>)

Images



Briefing Chart Image

Integrating ISHM with Flight Avionics Architectures for Cyber-Physical Space Systems, Phase I (<https://techport.nasa.gov/image/127217>)



Final Summary Chart Image

Integrating ISHM with Flight Avionics Architectures for Cyber-Physical Space Systems, Phase I Project Image (<https://techport.nasa.gov/image/132476>)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - TX07.3 Mission Operations and Safety
 - TX07.3.2 Integrated Flight Operations Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System